

## REMARKS

Further and favorable reconsideration is respectfully requested in view of the foregoing amendments and following remarks.

Initially, the specification has been amended to insert a paragraph at the bottom of page 13 concerning the deposit numbers for the strains referred to in claims 1 and 2 and the abstract. A copy of the ATCC Receipt of Deposit for these strains is enclosed. Referring to In re Lundak, 227 USPQ 90, Applicants respectfully submit that these amendments do not constitute new matter.

The Abstract has been rewritten to insert the deposit numbers and delete legal expressions.

Attached hereto is a marked-up version of the changes made to the abstract by the current amendment. The attached page is captioned "Version with markings to show changes made."

All of original claims 1-20 have been cancelled in favor of new claims 21-38, which have been drafted in a manner to overcome, with one exception, the grounds for rejecting the claims under the second paragraph of 35 U.S.C. §112. The only remaining ground for this rejection, which is respectfully traversed, is based on the Examiner's position that the units °Be' render the claims confusing.

In this regard the symbol °Be' represents the baume density, which has a corresponding specific gravity value. [For example, referring to new claim 21, a density of 25.5 °Be' corresponds to a specific gravity of 1.213, and a density of 29 °Be' corresponds to a specific gravity of 1.250.] Units of baume density are conventionally used by many companies which produce salt.

For these reasons, Applicants take the position that the rejection of the claims under 35 U.S.C. §112 should be withdrawn.

The rejection of claims 2-9 under 35 U.S.C. §101 has been rendered moot in view of the amendments to the claims.

Applicants note that the claim amendments include the cancellation of claim 1, drawn to non-elected subject matter. This claim has been cancelled without prejudice to Applicants' rights under 35 U.S.C. §121 to file a divisional application for claim 1.

The patentability of the present invention over the disclosures of the references relied upon by the Examiner in rejecting the claims will be apparent upon consideration of the following remarks.

Thus, the rejection of claims 2-9 under 35 U.S.C. §102(b) as being anticipated by Pillai, as well as the rejection of claims 2-20 under 35 U.S.C. §103(a) as being unpatentable over Heath et al. taken with Pillai and Miller, are respectfully traversed.

Uptake of calcium by marine cyanobacteria is well known and also clearly mentioned in the present application. However, its application for production of salt is new. It would not be appropriate to assume that the latter is obvious since no one has reported either in publications or in patents any manufacture of salt by this approach. Applicants believe the reason for that is the non-obviousness of the invention, since inter-disciplinary thinking is involved and that, in fact, was the main spark behind the present invention.

The non-obviousness of the invention is further evident from the additional points below.

Salt production requires raising brine density to high levels, i.e. from around 3% NaCl in seawater to around 25% NaCl for onset of NaCl crystallization. Prior to crystallization of salt, a large proportion of the calcium ion in brine is eliminated in the form of gypsum. Applicants have exploited this phenomenon to treat concentrated brine rather than seawater so as to minimize the load on the cyanobacteria. The higher concentrations of brine also minimize the volume of brine to be handled. It is not obvious from the prior art that cyanobacteria can survive these much higher concentrations of brine, and also whether they would retain their ability to absorb residual calcium from such concentrated brine after elimination of gypsum. Quite the contrary, the summary of the article of Pillai clearly indicates that except for *Phormidium tenue*, all the other algae die and disintegrate beyond chloride concentration of 1700 mM, i.e., around 10% (w/v) NaCl, whereas to make the present invention practical, the brine subjected to treatment has a NaCl concentration as high as 22% and the cyanobacteria remains both alive and functionally viable in this hypersaline condition. This is because the cyanobacteria of the present invention is collected from hyper-saline sources in the west seacoast of India.

The Pillai, Miller and Heath et al. references only consider the issue of uptake of calcium ions by cyanobacteria. This would be relevant only if the biomass is utilized on a "once-off" basis, where the cyanobacteria is filtered and discarded. The success of the present invention depends not only on the uptake of calcium ion but also on its oozing out in dilute brine with a certain periodicity, so that the cyanobacteria can once again perform its function of taking up calcium ion from a fresh batch of concentrated brine. This is what makes the method practical. The prior art does not allude to any

such periodic accumulation and release of calcium ion and therefore the present invention cannot be considered an obvious extension of the prior art. The reference to release of calcium ion in Pillai is vague and suggests that release occurs probably during the decay of the algae, whereas in the present invention accumulation and release of calcium ions occurs with live material, and exploits the cyclicity of activity discovered in the course of the present invention.

The present invention concerns a live biological system, contrary to the system proposed by Miller which pertains to dead proteinaceous material. It is precisely because the cyanobacteria of the present invention remains viable throughout the method of the invention that the biomass can be recycled by exploiting the growth and declining phases of calcium ion activity. Besides, the process described by Miller is much more complex and involves use of noxious chemicals, whereas the present method is eco-friendly.

The invention would be most practical if no external inputs such as nutrients or chemicals are required for the production of salt with reduced calcium impurity. The present invention accomplishes that, in as much as the cyanobacteria draws its nutrient from the brine itself. Moreover, the method can be carried out under ambient condition in salt pans with the use of solar energy and carbon dioxide from the atmosphere.


For these reasons, Applicants take the position that the presently claimed invention is patentable over the applied references.

Therefore, in view of the foregoing amendments and remarks, it is submitted that each of the grounds of rejection set forth by the Examiner has been overcome, and that the application is in condition for allowance. Such allowance is solicited.

Respectfully submitted,

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Version with Markings to  
Show Changes Made

ABSTRACT

This invention relates to new use of marine cyano bacterium *Lyngbya*, *Oscillatoria*, *Spirulina*, *Anabaena* and *Synechocystis* being deposited with ATCC having accession no. ~~for~~ <sup>by</sup> for the removal of calcium ions from sea-brine and sub-soil brine having density range 10 to 25.5°Be', ~~said use comprising~~ <sup>separating</sup> culturing the cyanobacteria, inoculating the said cyanobacteria culture to raw brine of 10 to 25.5°Be', filtering the resultant mixture to obtain a brine having less calcium, and ~~to separate~~ the cyanobacteria which can be reused if desired.

TITLE

An Improved Process For The Removal Of Calcium Ions From The Brine By Marine Cyanobacteria

numbers ATCC PTA-4602 and 4603

# ATCC

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## BUDAPEST TREATY ON THE INTERNATIONAL RECOGNITION OF THE DEPOSIT OF MICROORGANISMS FOR THE PURPOSES OF PATENT PROCEDURE

### INTERNATIONAL FORM

#### RECEIPT IN THE CASE OF AN ORIGINAL DEPOSIT ISSUED PURSUANT TO RULE 7.3 AND VIABILITY STATEMENT ISSUED PURSUANT TO RULE 10.



To: (Name and Address of Depositor or Attorney)

Council of Scientific & Industrial Research (CSIR)  
Attn: Dr. Sandhya Mishra  
G.B. Marg  
Bhavnagar-364002,  
Gujarat India

Deposited on Behalf of: Council of Scientific & Industrial Research (CSIR), N. Delhi, India

#### Identification Reference by Depositor:

Lyngbya aestuarii: SM-1  
Consortium of Lyngbya sp., Oscillatoria sp., Anabaena sp.,  
Spirulina sp., and Synechocystis sp.

#### Patent Deposit Designation

PTA-4602

PTA-4603

The deposits were accompanied by:    a scientific description    a proposed taxonomic description indicated above. The deposits were received August 19, 2002 by this International Depository Authority and have been accepted.

AT YOUR REQUEST:   X   We will inform you of requests for the strains for 30 years.

The strains will be made available if a patent office signatory to the Budapest Treaty certifies one's right to receive, or if a U.S. Patent is issued citing the strains, and ATCC is instructed by the United States Patent & Trademark Office or the depositor to release said strains.

If the cultures should die or be destroyed during the effective term of the deposit, it shall be your responsibility to replace them with living cultures of the same.

The strains will be maintained for a period of at least 30 years from date of deposit, or five years after the most recent request for a sample, whichever is longer. The United States and many other countries are signatory to the Budapest Treaty.

The viability of the cultures cited above was tested August 30, 2002. On that date, the cultures were viable.

International Depository Authority: American Type Culture Collection, Manassas, VA 20110-2209 USA.

Signature of person having authority to represent ATCC:

Marie Harris  
Marie Harris, Patent Specialist, ATCC Patent Depository

Date: October 3, 2002

cc: Michael R. Davis, Esq.  
(Ref: Docket or Case No.: 20010120A)